Marine Life Protection Act Initiative

Marine Habitats, Ecosystems and Ecosystem Services in the North Coast Study Region

Presentation to the MLPA Blue Ribbon Task Force
January 14, 2010 • Crescent City, CA

Steve Rumrill, MLPA Master Plan Science Advisory Team
South Slough National Estuarine Research Reserve (Charleston, OR)

MLPA North Coast Study Region

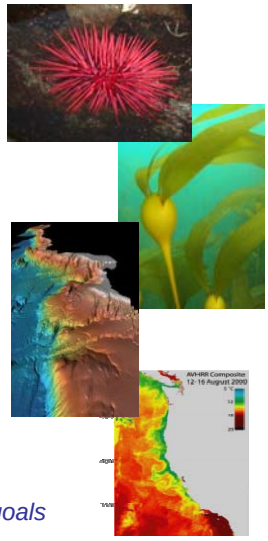

South Beach / Crescent City

Outline

1. **MLPA Goals for Habitats and Ecosystems**
2. **North Coast Study Region (NCSR)**
3. **Marine and Estuarine Habitats**
4. **NCSR Marine Ecosystem Functions**
5. **NCSR Marine Ecosystem Services**

Marine Life Protection Act Goals

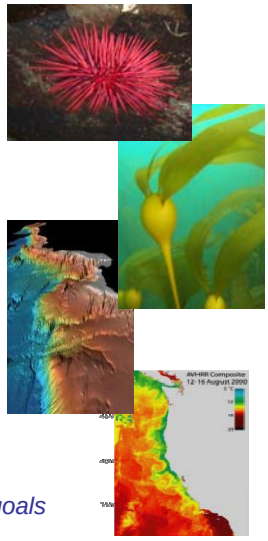
1. Protect **natural diversity** and **ecosystem functions**.
2. Sustain and restore marine life **populations**.
3. Improve recreational, educational, and study **opportunities**.
4. Protect representative and unique **habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. Ensure that MPAs are designed and managed as **a network**.



** Note: this language represents a summary of the MLPA goals*

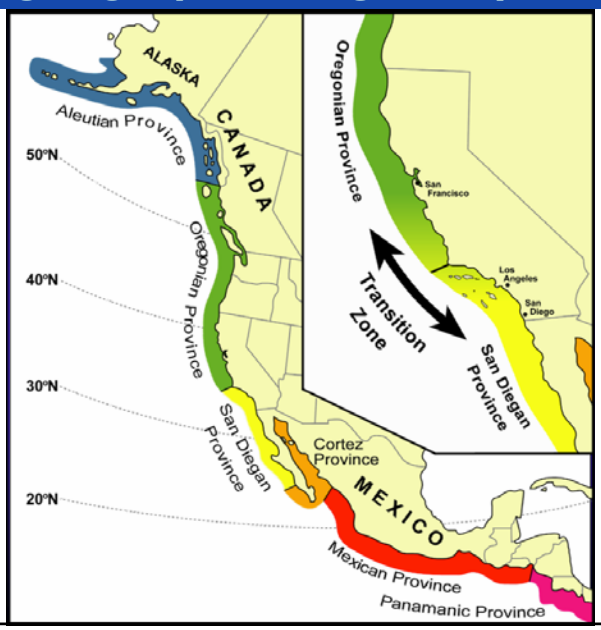
Goals for Habitats and Ecosystems

1. Protect **natural diversity** and **ecosystem functions**.
2. Sustain and restore marine life **populations**.
3. Improve recreational, educational, and study **opportunities**.
4. Protect representative and unique **habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. Ensure that MPAs are designed and managed as **a network**.

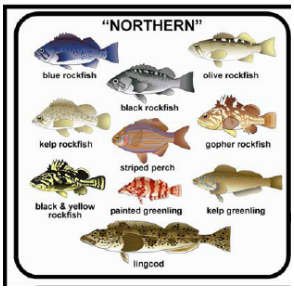


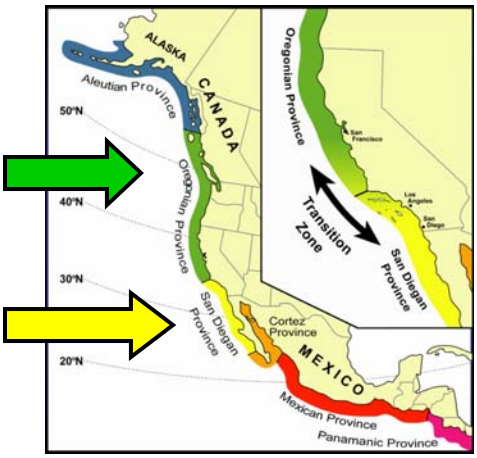
** Note: this language represents a summary of the MLPA goals*

Biogeographic Regions (Provinces)



Fish Assemblages by Biogeographic Regions





North Coast Study Region (NCSR)

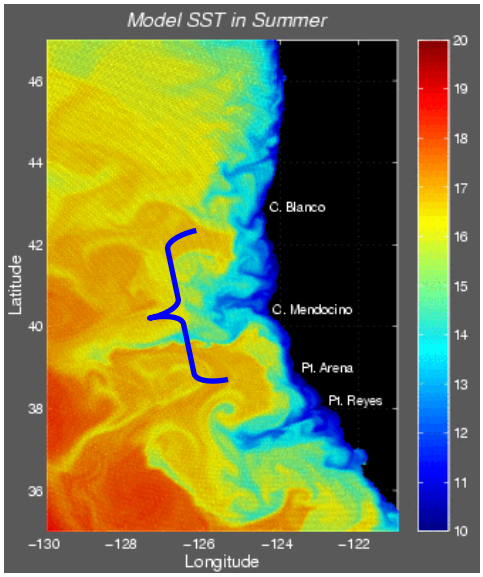
Oregonian Province

North Coast Study Region:

- **California / Oregon border to Alder Creek near Point Arena**

Nearshore Oceanography of NCSR

- **Colder sea surface temperatures (SST) along the shore**
- **Intense upwelling regions and offshore jets in summer**
- **Upwelling center located at Cape Mendocino**



Biogeographic Transition Zone

Surf smelt

Topsmelt

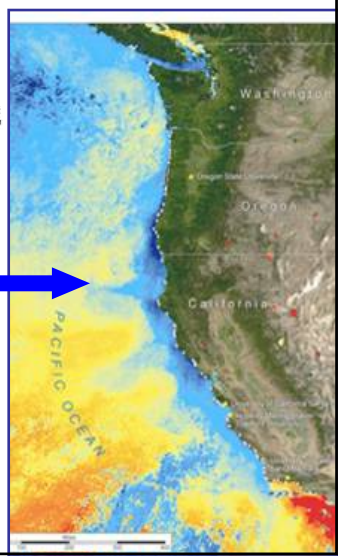
Estuary	A	S	J	L	E
Puget Sound	●	●	◉	◉	●
Hood Canal	◉	●	◉	●	●
Skagit Bay	◉	●	◉	●	●
Grays Harbor	○		○	○	
Willapa Bay	○		○	○	
Columbia River	○		◉	○	
Nehalem Bay	●		●	○	
Tillamook Bay	●		●	○	
Netarts Bay	√		●	○	
Siletz River	◉		◉	○	
Yaquina Bay	○		●	○	
Alsea River	○		●	○	
Siuslaw River	●		●	○	
Umpqua River	●		●	○	
Coos Bay	◉		●	○	
Rogue River	√		◉	○	
Klamath River	√		○		
Humboldt Bay	○		◉	○	
Eel River	○		●	○	
Tomales Bay	○		○	○	
Cent. San Fran. Bay *	√		√		
South San Fran. Bay	√		√		
Elkhorn Slough			√		
Morro Bay					
Santa Monica Bay					
San Pedro Bay					
Alamitos Bay					
Anaheim Bay					
Newport Bay					
Mission Bay					
San Diego Bay					
Tijuana Estuary					

Estuary	A	S	J	L	E
Puget Sound					
Hood Canal					
Skagit Bay					
Grays Harbor	√		√		
Willapa Bay	√		√		
Columbia River	√		√		
Nehalem Bay	√		√		
Tillamook Bay	○		○		
Netarts Bay	◉	◉	◉	○	◉
Siletz River					
Yaquina Bay	◉	◉	●	○	◉
Alsea River	○	○	○	○	○
Siuslaw River	◉	◉	◉	○	◉
Umpqua River	○		○		
Coos Bay	●	●	●	○	●
Rogue River					
Klamath River					
Humboldt Bay	○	○	○	○	○
Eel River	○	○	○	○	○
Tomales Bay	◉	◉	●	◉	◉
Cent. San Fran. Bay *	○		○	○	
South San Fran. Bay	◉	●	●	◉	●
Elkhorn Slough	●	●	●	◉	●
Morro Bay	●	●	●	◉	●
Santa Monica Bay	◉	○	◉	○	○
San Pedro Bay	◉	○	◉	○	○
Alamitos Bay	◉	◉	●	◉	◉
Anaheim Bay	◉	◉	●	◉	◉
Newport Bay	◉	◉	●	○	◉
Mission Bay	◉	◉	●	○	◉
San Diego Bay	◉	◉	●	○	◉
Tijuana Estuary	●	●	●	●	●

Relative abundance:
- ● Highly abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not present

Life stage:
A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

* Includes Central San Francisco, Suisun, and San Pablo bays.



North Coast Bioregions

Bioregion Break Near Cape Mendocino

Mattole River Mouth

1. Divides two major reef systems
2. Different upwelling regimes
3. Barrier to population connectivity
4. Distinct geomorphology and hydrology

Key Marine Habitats for NCSR

Shoreline
- Rocky shores
- Sandy beaches
- Surfgrass

Rocky Reef
- Kelp / kelp beds
- Rocky reef 0-30 m
- Rocky reef 30-100 m
- Rocky reef 100-200 m
- Rocky reef >200 m
- Pinnacles

Soft Bottom
- Soft bottom 0-30 m
- Soft bottom 30-100 m
- Soft bottom 100-200 m
- Soft bottom >200m
- Submarine canyons

Estuarine
- Coastal marsh
- Tide flats
- Estuarine waters
- Eelgrass beds

Oceanographic Habitats
- Upwelling areas
- Retention zones
- River plumes
- Oceanographic fronts

Note: blue habitats have special data considerations or limitations

Unique Marine Habitats in NCSR

- **Seastacks and offshore rocks/islands**
- **Sunken river estuaries**
- **Freshwater-influenced beaches**


Trinidad Head


Albion

North Coast Marine Habitats

From: *Regional Profile of the North Coast Study Region* (2009) and MLPA staff (2010)

Habitat	Total Amount (linear or square miles)
Total Study Area	1026.5 square miles
Total shoreline	520 miles
Intertidal: Rocky shores	160 miles
Intertidal: Sandy beaches	180 miles
Intertidal: Coastal marsh	3.5 square miles
Intertidal: Tidal flats	65 miles
Estuary	43 square miles
Eelgrass	6.1 square miles
Kelp beds	52 miles

Note: blue habitats have special data considerations or limitations

North Coast Seafloor Habitats

From: *Regional Profile of the North Coast Study Region* (2009) and MLPA staff (2010)

Habitat (Bottom Type)	Total Amount (square miles)
Total Study Area	1026.5 square miles
Hard (0 - 30 meters)	23 square miles*
Hard (30 - 100 meters)	18 square miles*
Hard (100 - 200 meters)	0.2 square miles*
Soft (0 - 30 meters)	210 square miles*
Soft (30 - 100 meters)	320 square miles*
Soft (100 - 200 meters)	38 square miles*
Unknown (all depths)	420 square miles*

* high resolution substrate data not yet available for the entire study region area

Note: blue habitats have special data considerations or limitations

NCSR Intertidal Shoreline Habitats

- **Sandy beaches / 35%**
- **Rocky shores / 31%**
- **Coastal marshes / 17%**
- **Tidal flats / 13%**


Fort Bragg Beach

Note: values indicate % of linear shoreline habitat in NCSR


Photo: National Park Service

Landforms and Features in NCSR

Headlands, Sandy Shores, Boulder Fields, and Creeks


Trinidad Head


Damnation Creek / RNP

Landforms and Features in NCSR

Terraces, Cliffs, Coves, and Surge Channels

Rocky Intertidal Benches and Tidepools

Rocky Intertidal Zone

- Occurs along 31% of the shoreline in NCSR
- Diverse communities of seaweeds, invertebrates, fish and shorebirds
- Scientific studies of zonation, predation, competition and other ecological processes

Estuaries and Lagoons

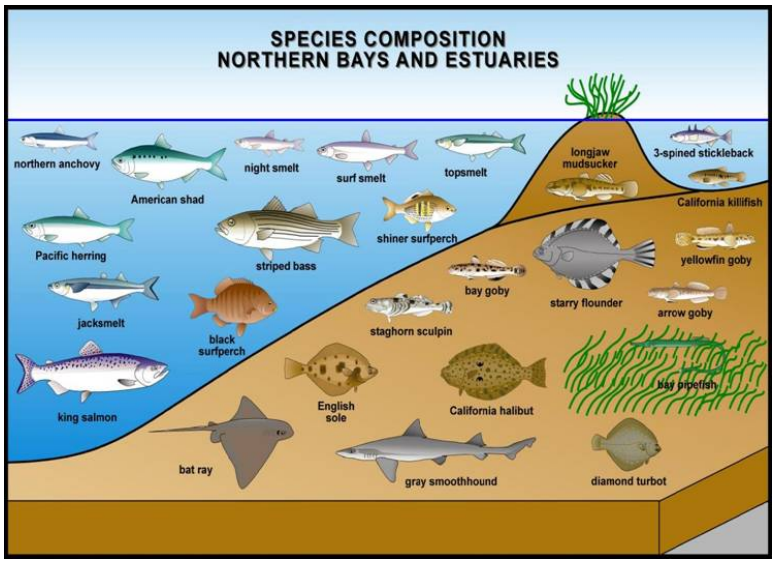
Transitional salinity zones between marine and freshwater environments

Productive habitats for invertebrates, fishes, shorebirds, seabirds and waterfowl

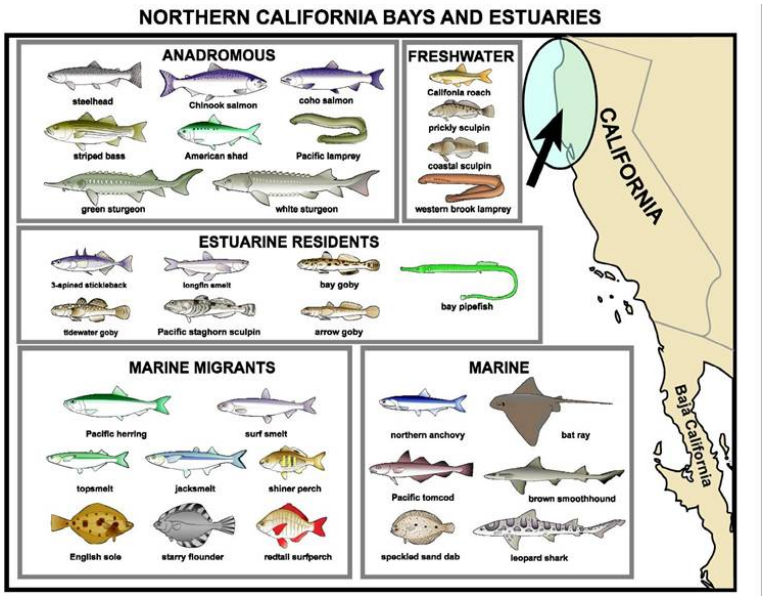
- Smith River Estuary
- Lake Earl
- Klamath River Estuary
- Redwood Creek Estuary
- Stone Lagoon
- Big Lagoon
- Little River Estuary
- Mad River Estuary
- Humboldt Bay
- Eel River Estuary
- Mattole River Estuary
- Ten Mile River Estuary
- Noyo River Estuary
- Big River Estuary
- Albion River Estuary
- Navarro River Estuary

** Note that this is not a comprehensive list of estuaries and lagoons*

Northern CA Bays and Estuaries



Fish Communities in Bays and Estuaries



Eelgrass and Surfgrass in the NCSR

- Surfgrass (*Phyllospadix* spp.) occurs along an unknown (< 31%) of the NCSR shoreline
  - Persistent patches and beds that fringe rocky coastline in shallow waters
  - Important habitat for a variety of fish, invertebrates, and algae

- Eelgrass (*Zostera* spp.) occupies 6.1 mi^2 (< 1%) of the NCSR shoreline but is not well mapped
  - Forms extensive beds in Humboldt Bay and also occurs in smaller estuaries
  - Stabilizes soft sediments, improves water quality, and provides refuge, foraging, breeding and nursery areas for invertebrates, fish and birds

Landforms and Features in the NCSR

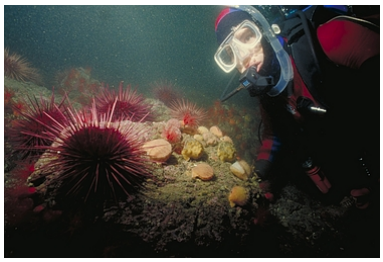
Offshore Seastacks, Promontories, and Cliffs

River Mouths and Estuaries

Shallow Sub-tidal Habitat in NCSR

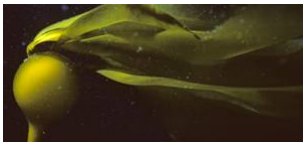
Bull Kelp Beds

Sub-tidal Bedrock and Reefs



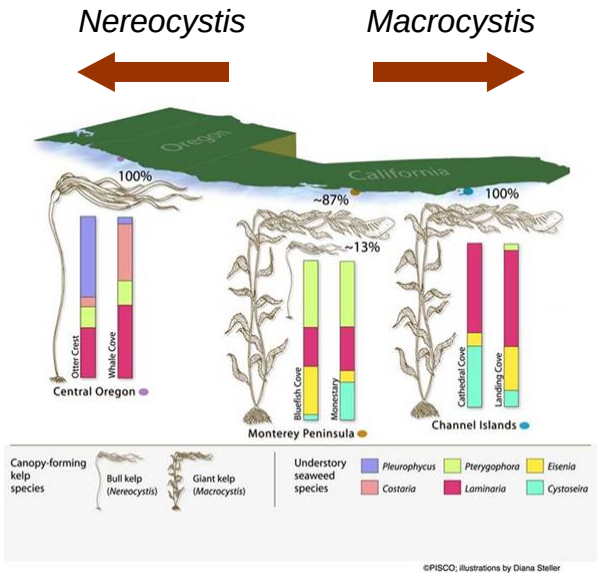
Bull Kelp Beds in the NCSR

- **Bull kelp (*Nereocystis luetkeana*) is the dominant canopy-forming kelp in subtidal zone**
- **Dense-patchy beds occur at depths of 3 to 20 meters on bedrock, boulders and reefs**
- **Contribute to productivity of shallow coastal marine ecosystem**
- **Provides habitat, feeding grounds and nursery areas for fish, invertebrates, and marine mammals**



Bull Kelp Beds in the NCSR

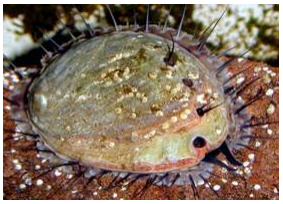
- Kelp beds in the NCSR occur in a latitudinal transition area
- Bull kelp (*Nereocystis*)
- Giant kelp (*Macrocystis*)



NCSR Marine Ecosystem Functions

Complex Food Web and Trophic Relationships in Northern California Bull Kelp Beds

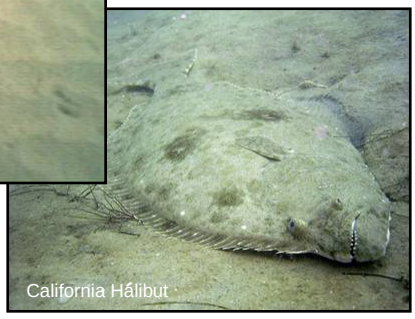


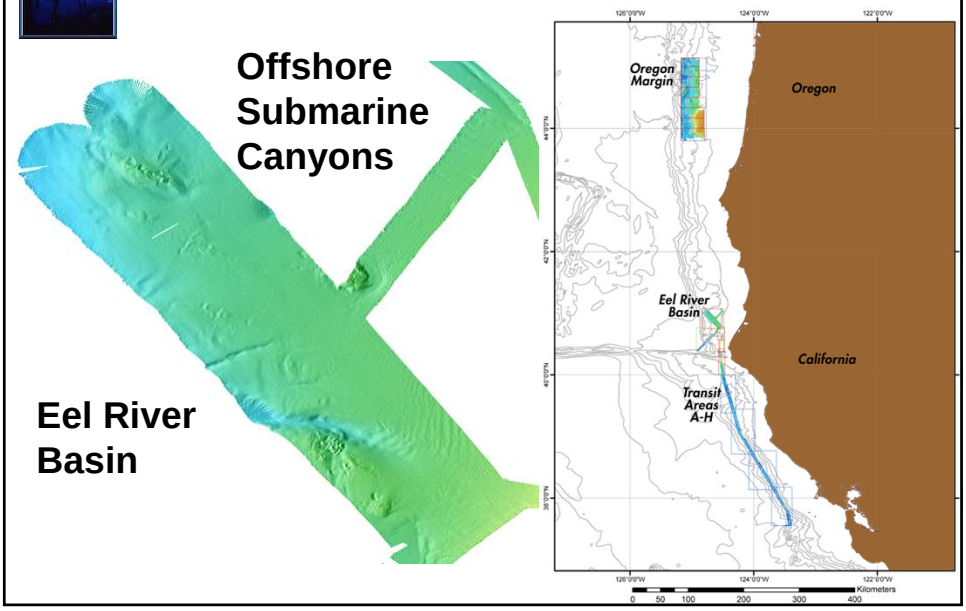

Landforms and Features in NCSR

Sub-tidal Sand, Sandy/Mud Soft-bottoms

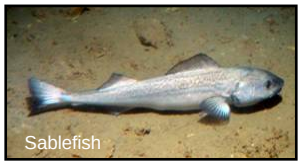

Dungeness crab


California Hálibut

Deep-water Landforms in NCSR



Soft and Hard Bottom Habitats


Sablefish

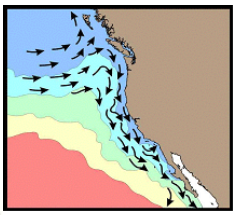

Copper rockfish

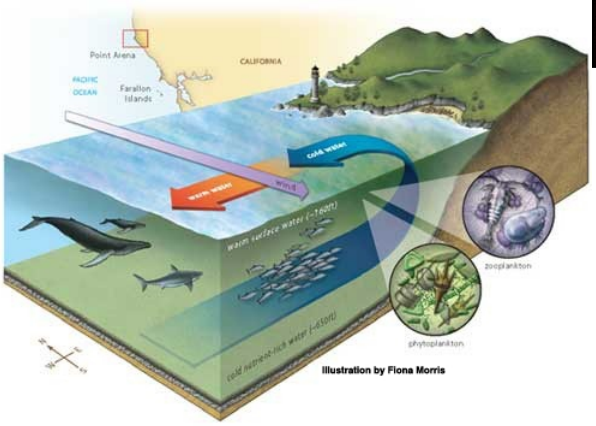
?

- **Soft bottom, including sand and sandy-mud, constitutes 93% of the mapped seafloor within the NCSR**
- **Hard bottom, including rocky reef, bedrock and boulder, constitutes only about 7% of the mapped seafloor, but supports higher diversity of kelps, seaweeds, invertebrates, and fishes**
- **Mapping information has not yet been processed for a portion (41%) of the total bottom habitat in the NCSR**

NCSR Marine Ecosystem Functions

California Current and Seasonal Upwelling





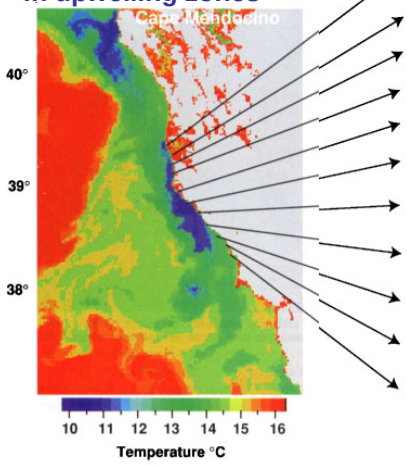
- Cold nutrient-rich water upwelled close to shore
- Fuel for marine ecosystem productivity

Ecosystem Functions

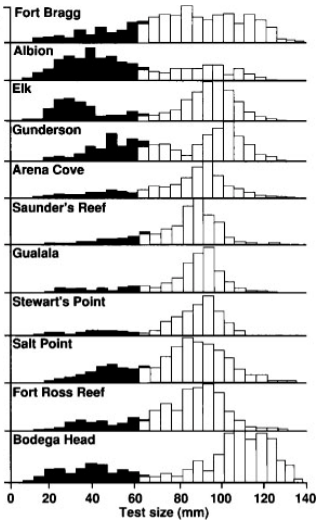
Latitudinal gradients and link between upwelling, temperature, and recruitment of red sea urchins

Sea Surface Temp

Poor urchin recruitment in upwelling zones



Sea Urchin Size



Marine Ecosystem Services

"marine resources and processes that are valued by humans"

Fisheries (commercial fisheries including crab, urchins, herring, halibut, tuna, rockfish, flatfish, shrimp, salmon)

Seaweed harvests (*Postelsia, Laminaria, Alaria, Porphyra*)

Aquaculture (shellfish in estuaries, potential offshore net-pens for finfish)

Nursery Habitat (rocky reefs, kelp forest, rocky intertidal, estuaries, marshes)

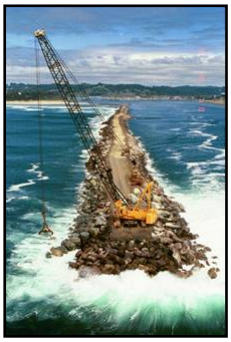
Coastal Protection (bluffs, kelp forest, rocky reef, estuaries, eelgrass, marshes)

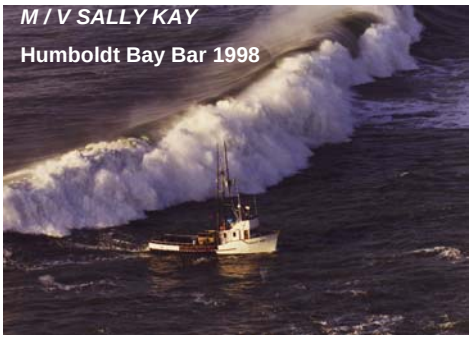
Ocean Wave Energy (highest potential on CA shoreline)

Tourism and Recreation (recreational fishing, sightseeing, surfing, hiking, camping, boating, cycling, kayaking, diving, etc.)

Ecosystem Services Trade-offs

Safe Bar Crossings, Estuary Hydrodynamics, and Tidal Wetlands





Metrics:

- **Jetty repair $**
- **Dredging $**
- **Boater lives saved**
- **Eelgrass area**
- **Marsh area**

Ecosystem Services Trade-offs

No-Take Marine Reserves and Recreational Fishing


Lingcod: *Ophiodon elongatus*

Metrics:

- **Fish biomass (weight per area)**
- **Fish density (number per area)**
- **Fish population size & age structure**

Metrics:

- **Fish species & size**
- **Number of fish caught per trip**
- **Cost per hour & cost per fish**

Ecosystem Services Trade-offs

Water Quality Protection / Nursery Habitat and Shellfish Mariculture

Metrics:

- Eelgrass area (% cover)
- Eelgrass density (number plants per area)
- Essential Fish Habitat (area)
- Oyster stocking density (# oysters per area)
- Mariculture production (quantity) (profit $)

Applying Habitat Knowledge to MPAs

Given the complexity and variability of marine habitats, design MPAs to include:

- Key and unique marine habitats, characterized by seafloor type, depth, oceanographic properties and biogenic structure
- Multiple examples (replicates) of each habitat type within a network of MPAs
- A mixture of habitat types in each MPA to represent the greatest number of species